Supporting Predictive Models Results Interpretation for Comfortable Workplaces

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1 Extended abstract

Approximately 90% of people spend most of their time in buildings, so feeling comfortable while staying indoors is a must. Although many times being an overlooked factor, research has proven that having an uncomfortable thermal situation involves many risks including clinical diseases, health impairments, and reduced human performance and work capacity. Therefore, there is a need to establish HVAC (Heating, Ventilation and Air Conditioning) control strategies that ensure comfortable thermal situations in these environments. Most times, workplaces are complex buildings which cannot be climatized with rather simple systems like a thermostat-based reactive one. Thus, KDD (Knowledge Discovery in Databases) processes may be applied by data analysts to create predictive models that identify optimal HVAC control strategies that will ensure thermal comfort within a workplace. The EEPSA (Energy Efficiency Prediction Semantic Assistant) process assists data analysts through this KDD process, which can be arduous and very time-consuming when there is a lack of sufficient domain knowledge. For that purpose, it takes leverage of the Semantic Technologies such as the EEPSA ontology[3] which aims to capture all the necessary expert knowledge related to buildings, sensing and actuating devices, and their corresponding observations and actuations. EROSO (thERmal cOmfort SOlution) is a framework that combines KDD processes and Semantic Technologies for ensuring thermal comfort in workplaces. Specifically, EROSO supports the KDD's Interpretation phase where Semantic Technologies are used to obtain an explanation of predictive model's temperature predictions with regards to the thermal comfort regulations they satisfy. Furthermore, this result interpretation supports facility managers in the task of selecting the optimal HVAC control strategies.

The EEPSA process facilitates the construction of a predictive model to forecast the temperatures for the upcoming hours within a workplace, according to the different HVAC control strategies[4] used as input. The EROSO framework

[3] https://w3id.org/eepsa
[4] An HVAC control strategy example may be the activation of the HVAC system at 6:00 at 23°C until 14:00.

begins with the execution of this predictive model (see (1) in Figure 1). That is, for each HVAC control strategy used as input for the predictive model, a temperature prediction for the upcoming hours is obtained. Once these predictions are obtained, a Jena script is triggered (see (2) in Figure 1). This script annotates predictions data according to a domain ontology (the EEPSA ontology) and stores annotated data in an RDF Store. It also executes a set of predefined SPARQL Construct rules to classify predictions according to the thermal comfort regulations they are forecasted to satisfy. Facility managers use the graphic interface to select the thermal comfort regulation they want to have at their workplace (see (3) in Figure 1). This triggers the generation and execution of a SPARQL query against the RDF Store. This way, HVAC control strategies that are forecasted to satisfy the selected thermal regulation, are shown to facility managers. Finally, they select and implement the optimal HVAC control strategy in their workplace's BMS (Building Management System)[5] (see (4) in Figure 1).

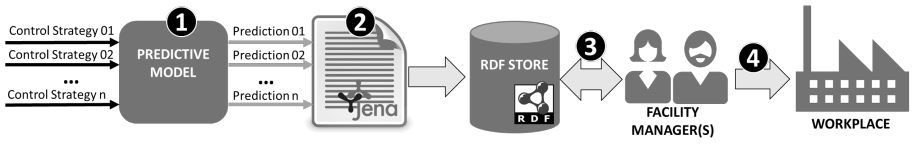

Fig. 1. EROSO framework's overview.

The EROSO framework has been implemented and tested in the Open Space, a large office where over 200 people work on a daily basis and is part of the IK4-TEKNIKER building located in Eibar (Spain). The implementation makes use of a predictive model generated as part of a previous research work to predict Open Space's temperature for the upcoming 24 hours. 20 different HVAC control strategies are used as inputs of the predictive model, so 20 different temperature predictions are obtained. This forecasting process is automatically executed daily at 17:00, so that the facility manager can make a decision on which HVAC control strategy to implement, in order to ensure next day's thermal comfort.

EROSO has been used by the IK4-Tekniker building manager and two workers. They have been surveyed and it has been demonstrated that the usability of the EROSO framework is overall good. Furthermore, the EROSO framework recommends HVAC control strategies that may ensure a satisfactory thermal comfort in the Open Space throughout the working day, while another previous solution implemented in the same physical space, may have periods when thermal comfort may not be achieved. The EROSO framework is expected to be implemented in further workplaces with different comfort requirements.

[5] A BMS (Building Management System) is the system in charge of setting HVAC control strategies in buildings.